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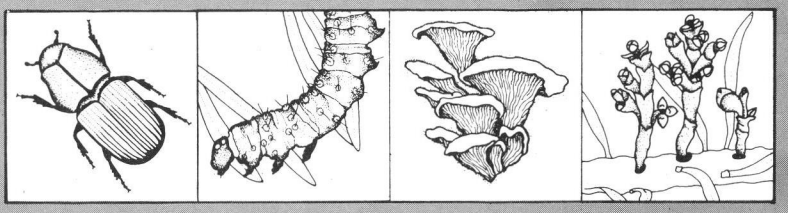

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ESTABLISHMENT REPORT OF THE WESTERN SPRUCE BUDWORM SILVICULTURAL DEMONSTRATION PROJECT ON THE GALLATIN AND LOLO NATIONAL FORESTS, MONTANA

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The western spruce budworm[4] is the major defoliator of Douglas-fir and true firs throughout many western States. The larvae feed on old needles, buds, and current year's foliage. Heavy feeding for 4 or 5 years can cause top killing, growth loss, and tree mortality. Cone and seed production is also significantly reduced.

In recent years there has been an increased awareness of silvicultural practices that could alter the interactions between budworm and its host and reduce stand damage through management (Wulf and Rogers 1981). Species conversion or favoring the intolerant component will reduce losses in subsequent stands (Williams 1966, 1967; Johnson and Denton 1975). When this is not feasible, prompt removal of host overstories and favoring even-aged stand structures may provide short-term protection until the trees are at the height when they again become desirable egg-laying targets. At that time either direct control efforts or further thinnings will be necessary to prevent damage.

The Canada/U.S. Spruce Budworms Program (CANUSA) is an accelerated research, development and applications program directed to develop new and improved management alternatives to cope with spruce budworm problems. In 1981, demonstration areas were established on the Lolo and Gallatin NF's to evaluate a series of silvicultural prescriptions designed to reduce western spruce budworm damage.

Silvicultural management systems demonstrated are: (1) clearcutting with planting, (2) shelterwood cutting, (3) seed tree, (4) overstory removal, and (5) group selection.

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Objectives

The objectives of these silvicultural demonstrations are to show:

1. How different cultural systems affect budworm populations.

2. How various cultural systems alter stand response in the presence of budworm.

3. How unmanaged stands respond to budworm defoliation.

4. How well the CANUSA developed decision system predicts various outcomes for each cultural system.

5. How cost effective various cultural systems are using economic models coupled with growth models that incorporate effects of spruce budworm.

Descriptions of Demonstration Areas

A. Location

The Gallatin NF demonstration area is located in Weasel Creek approximately 20 miles north of Bozeman in the Bridger Mountains. The Lolo NF demonstration area is located in the Ninemile drainage which is about 35 miles west of Missoula (figs. 1 and 2).

B. Outbreak History

Both demonstration areas have had a long history of spruce budworm damage. When established, the Gallatin NF area was at a low outbreak level; the Lolo area has been virtually uninfested for about 5 years. In the Lolo demonstration area, some of the understory trees have been killed and many display top killing from the 1968-1978 outbreak.

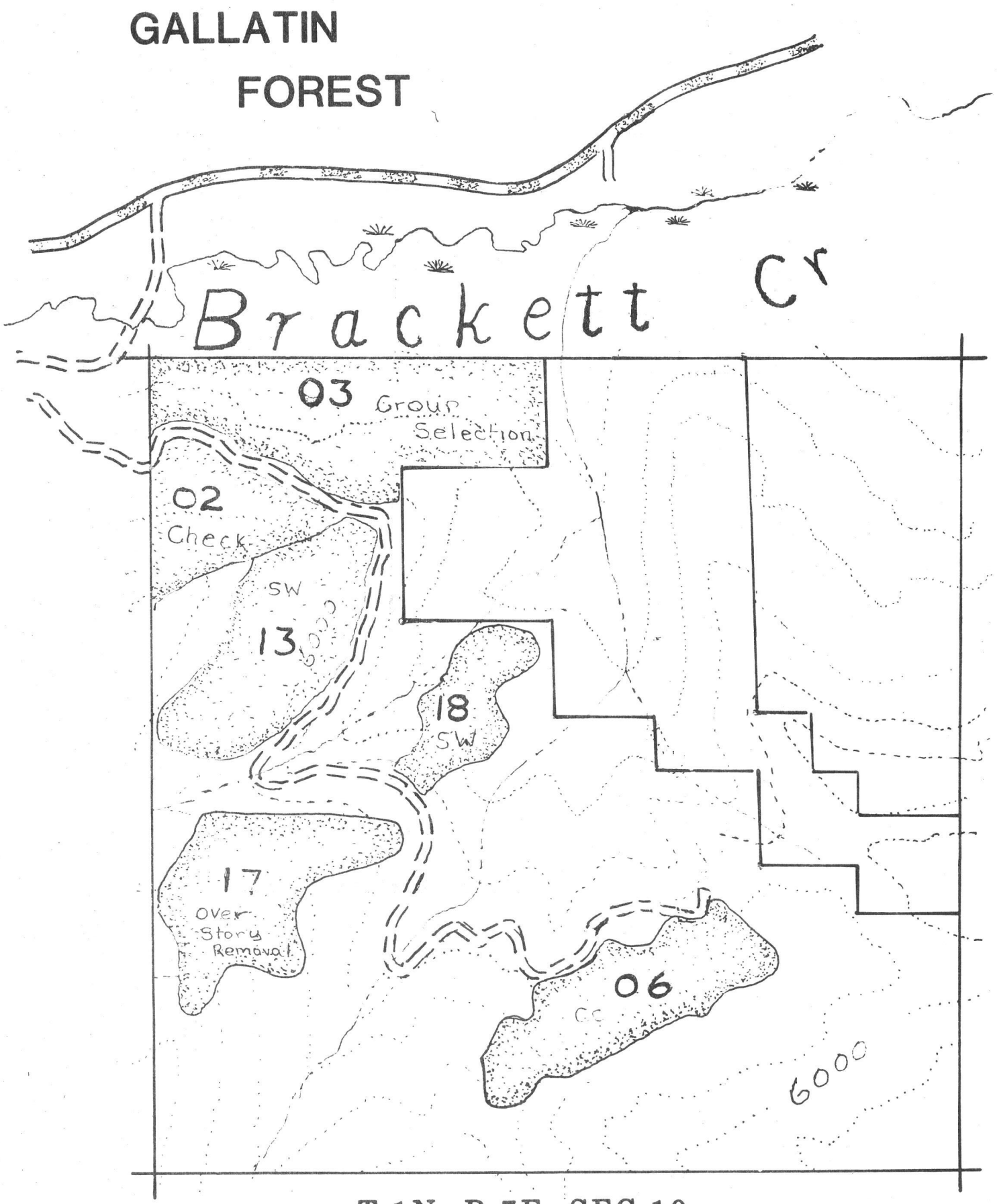
Stand Conditions

Stands on the Gallatin NF are mostly Douglas-fir and lodgepole pine with some subalpine fir and spruce. Species on the Lolo NF are more diversified and include grand fir, subalpine fir, larch, spruce, lodgepole, Douglas-fir, and some white pine and cedar.

A series of systematic sample points were established in each stand to determine preharvest conditions and stand structure. Basic stand examination data were obtained at each point. In addition, detailed spruce budworm damage conditions were recorded for each sample tree. The data were compiled and displayed by a computer program, INDIDS[5]. Pretreatment stocking levels are displayed in Tables 1, 2, 3 and 4.

[5]Bousfield, Wayne. 1978. Insect and disease damage survey system. USDA Forest Service, State and Private Forestry, Missoula, MT.

fig.1



T.1N. R.7E. SEC.10

fig.2

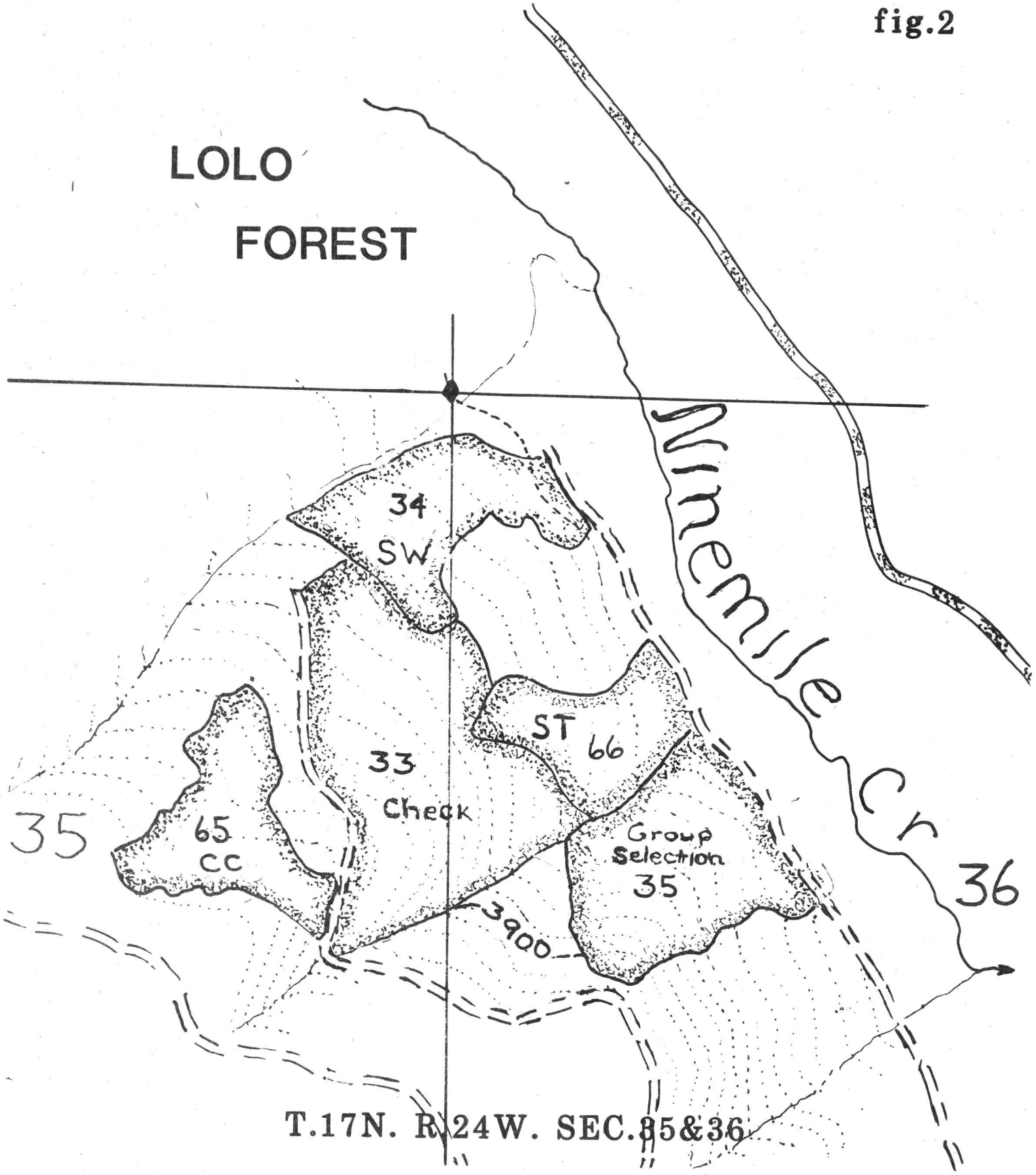

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Table 1.--Pretreatment stocking levels for basal area.

	Stand ident.	Gallatin National Forest Basal area				
		DF	S	SAF	LPP	Total
Check	02	182.8	0	0	33.3	216.1
Group selection	03	48.5	13.6	13.4	140.3	215.9
Clearcut	06	176.8	6.7	0	53.3	236.8
Shelterwood	13	171.1	0	0	0	171.1
Shelterwood	18	94.8	.1	.2	46.7	141.8
Overstory removal	17	61.4	0	1.8	37.0	100.3

	Stand ident.	Lolo National Forest Basal area							
		LP	L	DF	S	SAF	GF	Other[1]	Total
Check	33	76.8	34.3	17.5	0	59.4	17.4	0	205.4
Group selection	35	53.9	14.5	65.0	0	3.6	71.0	3.6	211.7
Shelterwood	34	40.00	35.9	19.4	0	10.0	80.1	9.9	195.3
Clearcut	65	0	52.2	16.3	22.3	8.0	24.0	.6	123.6
Seed tree	66	33.3	90.1	20.0	0	27.3	36.7	2.5	209.9

[1]White pine and cedar.

Table 2.--Pretreatment stocking levels for trees per acre.

	Stand ident	Gallatin National Forest Trees per acre				
		DF	S	SAF	LP	Total
Check	02	1491.3	9.0	300.0	101.2	1892.5
Group selection	03	528.6	807.1	1169.9	384.4	2889.8
Clearcut	04	1694.3	7.9	50.0	83.2	1835.4
Shelterwood	18	1242.7	250.0	300.0	64.4	1857.2
Overstory removal	17	1242.7	100.0	100.0	186.3	844.7

	Stand ident.	Lolo National Forest Trees per acre							
		LP	L	DF	S	SAF	GF	Other[1]	Total
Check	33	183.6	55.7	60.0	0	619.5	3971.9	85.8	5478.6
Group selection	35	53.9	20.1	339.2	0	65.5	1746.6	6.0	2516.0
Clearcut	65	145.6	196.9	422.7	75.0	101.6	1332.4	525.0	2769.2
Shelterwood	34	0	155.9	183.0	166.0	210.8	2836.1	60.0	3612.4
Seed tree	66	103.0	610.5	614.2	0	1107.3	6268.0	50.0	3102.8

[1]White pine and cedar.

Table 3.--Percent of the basal area displaying various levels of current defoliation for all tree species.

Treatment	Stand ident.	None[1] 0	Light 1-25%	Moderate 26-75%	Heavy 76-100%
		Gallatin National Forest			
Check	02	9.7	32.8	19.5	0
Group selection	03	73.4	7.2	6.2	0
Clearcut	06	21.4	19.7	14.1	0
Shelterwood	13	6.5	35.1	15.6	0
Shelterwood	18	30.5	15.1	9.5	.2
Overstory removal	17	0	11.9	14.2	13.3
		Lolo National Forest			
Check	33	83.8	0	0	0
Group selection	35	93.5	0	0	0
Clearcut	65	100	0	0	0
Shelterwood	34	100	0	0	0
Seed tree	66	90.9	0	0	0

[1]Totals will not add to 100 percent because some trees were given a rating for past effects of defoliation or top kill and would not be included in the 0 percent class.

Table 4.--Percent of trees per acre displaying various levels of current defoliation for all tree species.

Treatment	Stand	None[1]	Light	Moderate	Heavy
		Gallatin National Forest			
Check	02	60.7	9.1	12.7	0
Group selection	03	17.3	21.6	24.9	0
Clearcut	06	58.4	12.1	5.5	0
Shelterwood	13	76.9	6.2	5.8	0
Shelterwood	18	0	26.1	12.9	2.7
Overstory removal	17	0	12.1	37.2	5.8
		Lolo National Forest			
Check	33	96.0	0	0	0
Group selection	35	97.4	0	0	0
Clearcut	65	100	0	0	0
Shelterwood	34	100	0	0	0
Seed tree	66	93.1	0	0	0

[1]Totals will not add to 100 percent because some trees were given a rating for past defoliation or top kill or top kill and would not be included in the 0 percent class.

Insect Conditions

Western spruce budworm larvae were sampled on four tree sizes: 0-2 ft.; 2-6 ft.; 6 ft.-30 ft.; and 30 ft.-60 ft. At each sample point two branches from each tree class were removed and number of spruce budworm larvae were counted. On smaller trees the branches were not cut but the entire tree was used as the sample stratum. The size and number of shoots were recorded so that comparable density measurements could be obtained (Table 5). Larvae were collected and instar measurements made. All tree classes were not present on each plot. Percent instar development for all stands is shown in Table 6.

Table 5.--Summaries of larval densities per 100 shoots by tree class before harvest.

Gallatin National Forest

Stand ident.	Size tree class 0-2'	2'-6'	6'-30'	30'-60'	Average
02	0	1.28	8.21	2.62	3.03
03	0	0	1.31	.61	.48
06	0	0	1.48	1.07	.64
13	0	0	3.08	2.85	1.48
17	0	.61	.74	4.85	1.55
18	0	10.55	3.76	3.79	4.53
Average	0	1.88	3.10	2.63	

Lolo National Forest[1]

[1]Population levels were very low so determinations were not made.

Table 6.--Instar development.

Percent of budworm by development

INSTAR 4	5	6	P
1.0	16.4	64.0	18.6

Egg mass densities of western spruce budworm were sampled in each treatment area. Three clusters of three trees were sampled in each stand. Two 30-inch branch samples were removed from each tree. Foliage was examined under ultraviolet light to detect egg masses. The area of each sample branch was determined from its length and width. Densities of new egg masses per square meter were computed. Average egg mass densities are shown below:

Gallatin - $6.63/m^2$

Lolo - $.075/m^2$

Silvicultural Prescriptions

Gallatin NF

In Weasel Creek there are six stands included in the demonstration area. The following are preharvest descriptions of the six stands and the recommended regeneration cut is prescribed.

Stand 02, Check. This stand has a north-facing slope of about 25 percent. The elevation is 6,000 feet. The stand is producing 48.5 ft^3 per acre per year. The stand has 216 ft^2 of basal area and a volume of 4,257 ft^3 and 15,126 board ft per acre. Eighty-four percent of the basal area is Douglas-fir. Quadratic[6] mean diameter is 4.6 iches. This stand was selected to serve as the check.

Stand 03, Group Selection. This stand has a north-facing slope of about 20 percent and an elevation of 5,800 feet. The stand is in a midslope position and producing 84.7 ft^3 per acre per year. The stand has 216 basal area of which 23 percent is Douglas-fir, 6 percent spruce, 6 percent subalpine fir, and 65 percent lodgepole pine. Total volume of the stand is 5,626 ft^3 and 22,832 board feet. The quadratic mean diameter is 3.7 inches. Most of the lodgepole pine was removed from this stand. Treatment is to be group selection because mountain pine beetle is active in the area. This will reduce the basal area and alter the stand condition to effect dispersal and stimulate growth on individual trees.

Stand 06, Clearcut. This stand has a northwest-facing slope of 20 percent and the elevation is 6,000 feet. Total basal area is 236 ft^2 per acre. Douglas-fir comprised 75 percent of the basal area with lodgepole pine adding 22 percent and spruce and alpine fir comprising the remaining percentage. The quadratic mean diameter is 4.9 inches and is producing 55.3 ft^3/year. This stand will be clearcut and planted to Douglas-fir. Some natural regeneration is expected to occur.

Stand 13, Shelterwood. This stand has a southeast-facing slope of about 15 percent at an elevation of 5,800 feet. It has 171 ft^2 of basal area and a volume of 2,844 ft^3 and 9,605 board feet per acre. This is a pure Douglas-fir stand and was recommended to receive a shelterwood cut. The mean diameter is 4.9 and is producing 37.1 ft^3/year. The overstory will be removed after the stand has been regenerated.

[6]Diameter of tree of mean basal area (total BA/tree per acre).

Stand 17, Overstory Removal. This stand has a northeast exposure at an elevation of 5,800 feet. Basal area of this stand is 100 ft^2, and the volume is 1,208 ft^3 and 3,993 board feet per acre. The basal area consisted of 61 percent Douglas-fir, 37 percent lodgepole pine, and 2 percent subalpine fir. The quadratic mean diameter is 4.6 inches. The periodic annual increment is 14.3 ft^3/acre. This stand had the overstory to reduce populations on the advanced understory. A portion of the stand is understocked and may receive a planting of Douglas-fir.

Stand 18, Shelterwood. This stand is on a northeast-facing slope of 20 percent, with some advanced reproduction of Douglas-fir, Engelmann spruce, and subalpine fir. The stand is producing 31 ft^3 per acre per year. Basal area totaled 142 ft^2 per acre and a volume of 3,311 ft^3 and 14,432 board feet per acre. The quadratic mean diameter is 3.7 inches. The purpose of this cut is to remove some overstory to protect the residual advanced regeneration. This should reduce desirable ovaposition sites and increase larva mortality during dispersal.

Lolo NF

In Ninemile Creek, Lolo NF, there are five stands included in the demonstration area. Description of the five stands and recommended regeneration cuts are as follows.

Stand 33, Check. This stand will serve as a check and will not be harvested. It has an east aspect with a 15 percent slope. The elevation is 3,900 feet. Basal area of this stand is 265 ft^2 of which 8 percent is grand fir, 29 percent subalpine fir, 17 percent western larch, 37 percent lodgepole pine, and 9 percent Douglas-fir. It has a volume of 4,943 ft^3 and 16,241 board feet per acre. Periodic annual increment is 93.1 ft^3 per acre per year. Quadratic mean diameter is 4.6 inches.

Stand 34, Shelterwood. This stand has a northeast slope of 15 percent and elevation of 3,800 feet. Basal area of the stand is 123 ft^2 of which 20 percent is grand fir, 7 percent subalpine fir, 42 percent western larch, 13 percent Douglas-fir, and 18 percent Engelmann spruce. Volume of this stand is 2,207 ft^3 and 7,151 broad feet per acre. Periodic annual growth is 54.7 ft^3 per acre per year. Quadratic mean diameter is 2.5 inches.

This stand will receive a shelterwood cut removing most of the grand fir to favor western larch and Douglas-fir regeneration.

Stand 35, Group Selection. This stand has an east aspect with a 15 percent slope and the elevation is 3,800 feet. Basal area is 212 ft^2 per acre. Grand fir comprises 33 percent, subalpine fir 2 percent, western larch 7 percent, lodgepole pine 25 percent, western white pine 2 percent, and Douglas-fir 31 percent. There is a total of 4,547 ft^3 and 17,625 board feet per acre. Periodic annual growth is 70 ft^3 per acre per year. Quadratic mean diameter is 3.9 inches. This stand will receive a group select cut with most of the grand fir and subalpine fir being removed.

Stand 65, Clearcut. This stand has an east aspect, 15 percent slope, and the elevation is 4,000 feet. Basal area is 195 ft^2 per acre of which 41 percent is grand fir, 5 percent subalpine fir, 18 percent western larch, 21 percent lodgepole pine, 10 percent Douglas-fir, and 5 percent western redcedar. The quadratic mean diameter is 3.6 inches. Volume of the stand is 3,862 ft^3 and 12,155 board feet per acre. Current periodic annual increment is 50 ft^3 per acre per year. The stand will be clearcut and planted to western larch and Douglas-fir.

Stand 66, Seedtree Cut. This stand has an east aspect, the slope is 15 percent, and the elevation is 3,800 feet. Basal area is 209 ft^2 of which 17 percent is grand fir, 13 percent subalpine fir, 42 percent western larch, 16 percent lodgepole pine, 10 percent Dougals-fir, and 1 percent western redcedar. The stand has a volume of 4,116 ft^3 and 16,048 board feet per acre. The stand is producing 85.1 ft^3 per acre per year. This stand will receive a seedtree cut. Only the larger western larch trees will be left for regeneration.

Monitoring and Evaluation. The western spruce budworm populations will be sampled each year in all stands for larval and egg densities. Comparisons will be made between prescriptions. Tree response will be made at 5-year intervals. The stand prognosis model when coupled with the spruce budworm model will be used to forecast future stand tables for the different regeneration cuts. Economic models will be used to calculate present net worth and cost benefit ratios.

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